Schizokinesis: Fragmentation of Performance in Two Strains of Pointer Dogs

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Abstract—During the behavior shaping toward bar jumping to avoid shock at the termination of a tone, ten genetically nervous ("E") and ten stable ("A") dogs showed different performances in the acquisition of the adaptive motor response. When tested two months later and with concurrent monitoring of their electrocardiograms, these animals also showed differences in (1) baseline heart rate, (2) direction and degree of heart rate change to the conditioned tone stimulus (more often deceleration in the E dogs), and (3) response to the unconditioned shock stimulus.

After having performed in an almost satisfactory manner for a few trials, the *nervous* animals often would suddenly freeze in rigid postures. These animals could frequently be made to emit the adaptive behavior by "breaking the frozen posture" through pushing, jumping, or pulling manipulation. Sometimes a forced righting reflex dramatically encouraged an integrated performance of varying duration. The *stable* strain of dogs showed little or none of the rigidity and usually learned the smooth adaptive response.

The stable A dogs showed retention of the cardiac Cr, but not of the motor Cr (which they re-formed after one or two reenforcements); the nervous E dogs also retained the cardiac Cr, but persisted in the maladaptive motor performance.

The fragmented disorganized behavior in acquiring the adaptive motor act and the *differential retention* of the autonomic and motor responses are considered examples of *schizokinesis* as conceptualized by Gantt. This schism is seen in clearer form in behavioral acquisition than in the usual frequency measure of the well-practiced act.

QUITE OFTEN the primary data in behavior studies have to do with the frequency of fairly simple emitted instrumental or operant responses. These may consist of lever- or bar-pressing. The main interest is in the change in rate of the responses through time, as a result of reinforcement procedures or experimental conditions, including pharmaceutical agents. Less often, one sees reports of the actual acquisition phase of the behavioral response. Perhaps the simplicity of the response itself or the design of the data collection system prevents observation of the animal during the actual behavior shaping process. Not since maze studies have we seen the majority of reports in many psychology journals focusing on the acquisition phase of the behavioral response. The authors wish to report observations they have repetitively made while shaping the behavior

of nervous and stable pointer dogs. These observations, discussed below, have to do with discontinuous, fragmented, and disorganized performances which were noted while comparing the performances of a nervous and a stable strain of pointer dogs. These observations seem to be expressions of a condition which Gantt (1953) has called schizokinesis.

Materials and Methods

Subjects

Ten dogs were chosen from each of our two strains of the pointer breed. One strain, known as our E-line, breeds nearly true for nervousness, *i.e.*, is characterized by timidity, excessive startle, severe human aversion, and a strong tendency to display rigid or catatonic-like behavior. The other strain, our A-line, is almost free of the above traits though there is some overlap on behavioral tests (Murphree, *et al.*, 1967; Dykman, *et al.*, 1969). These two strains maintained in our laboratory over the past 11 years are the offspring of two original parent pairs. Our healthy strain has been augmented occasionally by outside matings in an attempt to improve fertility. All experimental animals have been reared in our laboratory, and a longitudinal study of them has been one of the major research efforts at VA Hospital, North Little Rock, Arkansas, in collaboration with the Department of Psychiatry of the University of Arkansas Medical School.

The study reported here is a further attempt to better understand these animals and is a blend of personnel and policies in the tradition of physiology and psychology stemming from Scott and Fuller (1965), Gantt, and Pavlov.

Integrated, Harmonious vs Blocked, Schizokinetic Behavioral Acquisition

Successful and integrated performance usually is as follows: The animal comes to avoid an electric shock (under remote radio control) by first following the experimenter and later by jumping a barrier placed midway in a paddock area 9 x 12 ft. The animal moves in a variety of directions with varying timing, making it relatively easy for the careful experimenter to select and reinforce closer and closer approximations to the desired behavior. We use a tone or other auditory stimulus as the signal for the impending electric shock, which is avoided if the animal performs the desired response. Well-performing animals will complete the task of barrier-jumping during, and only during, the sounding of the tone, with the experimenter out of the paddock, and in a surprisingly short number of times—sometimes a matter of a few sessions (Fig. 3). The whole procedure is smoothest when the animal offers a variety of activity

and responds to selective reinforcement (in the operant or instrumental sense, *i.e.*, avoiding the shock) to yield behavior "stretching" or shaping. The authors are aware that this is more a descriptive than an analytical-theoretical account of the behavior acquisition.

An example of a performance for which we believe the term schizokinetic is appropriate is as follows: As the attempted behavior shaping gets under way, the experimenter notices that the animal is responding in an unusual manner to the tone. Instead of exhibiting a variety of behavior which can be selectively reinforced, the animal often presents a frozen posture, perhaps a bizarre, awkward positioning of feet and/or head (Fig. 1). Such postures are presented frequently in the training session and offer little opportunity for selective reinforcement. Progress is apt to come to a complete halt that can last for many days. Sometimes, as the tone is sounded and the time of the unconditional stimulus approaches (5-10 seconds

FIG. 1. Nervous dog in rigid posture. He is thoroughly conditioned (Pavlovian) but schizokinetically blocked in instrumental responding.

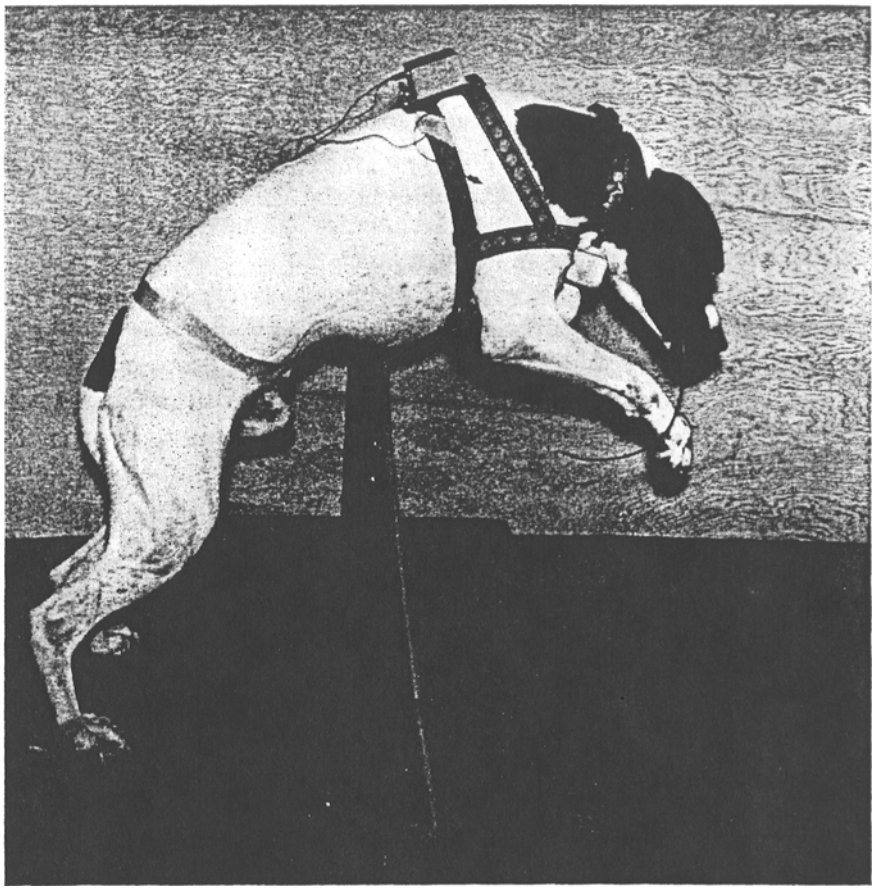

FIG. 2. Normal dog emitting bar-jumping response to avoid radio-controlled shock.

after onset of the tone), or in the absence of actual electric shock, the animal flinches and tightens his musculature (particularly in the area where the shock is to occur) giving evidence of his having been *conditioned* in the Pavlovian sense.

The above observations were made during a study of acquisition of the bar-jumping response in 20 dogs: 10 normal (A-line) and 10 nervous (E-line). After this initial study (Experiment 1), we developed an interest in the possibility that the strains might differ in the autonomic manifestations of conditioning. Thus, we carried out Experiment II.

Experiment I: Bar-Jumping

Method. Whenever possible, the dogs were trained in pairs; *i.e.*, an A dog and an E dog were given their sessions on the same days. Each session lasted 20 minutes, and the criterion established for successful overall performance consisted of at least 8 successive

bar-jumps in any series of 10 tones. Once criterion performance was reached, no additional training sessions were given until Experiment II.

Tones were presented manually by means of a small battery-operated oscillator-amplifier* of 3,000 cps held in one hand of the experimenter. If the dog did not perform the correct response (come to the experimenter early during training or jump the barrier during later training) within 5-10 seconds after the tone onset, he received a shock to the neck through a shock collar. The shock was activated by a radio transmitter held in the experimenter's other hand. If the correct response occurred, the tone was immediately terminated and shock was avoided. These trials were administered repeatedly throughout each 20-minute session.

Results. All E strain dogs and none of the A strain dogs "froze" or assumed rigid postures (only the eyes seeming free to move) at some time, but usually many times, during the training. However, as previously pointed out, these dogs could often be unfrozen and 5 E dogs eventually learned to jump the bar. Nine of the A dogs acquired the response (Fig. 3). These frequency discrepancies are

* Sonalert Model SC628A, Mallory Company, Inc.

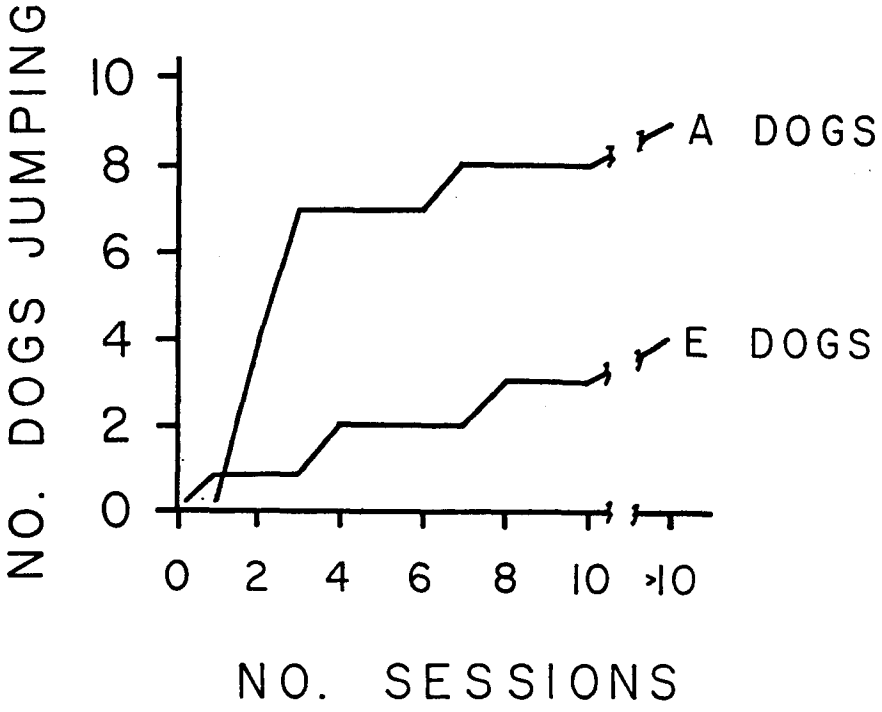

FIG. 3. Cumulative distribution of bar-jumping by daily session of stable (A) and nervous (E) dogs.

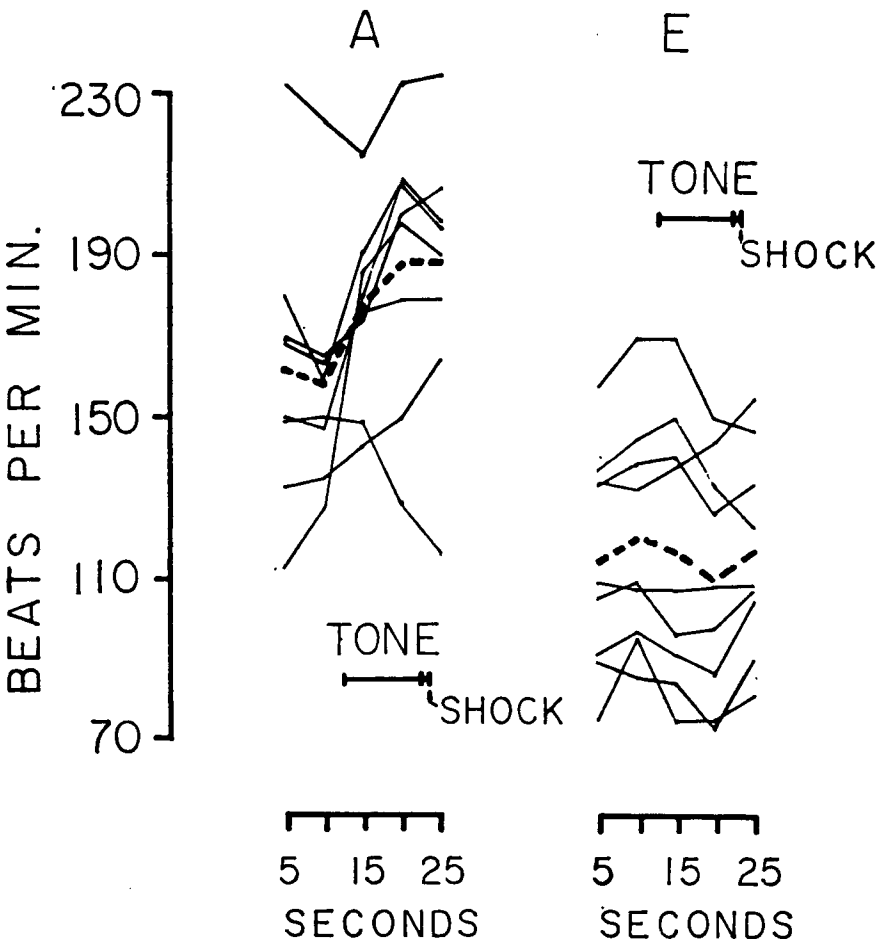

FIG. 4. Retention of heart rate conditioning of A and E dogs on first tone when tested 2 months after bar-jumping training. Note retention, i.e., increase in A dogs' rate during tone, though not of E dogs. Broken lines are means.

one short of significance by Fisher's Exact Test; however, this is arbitrary to the extent that, if left alone, many E dogs hold their rigid postures indefinitely so that their performances have been greatly enhanced by the technician's repeated efforts.

Experiment II: Retention Studies with EKG Monitoring

Method. Six to eight weeks after the end of Experiment I, the dogs were tested for retention of the bar-jumping response and for evidence of autonomic conditioning. A single session of 20 trials of tones was given. During each tone the dog had 10 seconds in which to jump the bar. If he jumped, the tone was immediately terminated and no shock occurred. If he did not jump within the 10 second period, the tone was terminated simultaneously with onset of a 1-second shock through the shock collar.

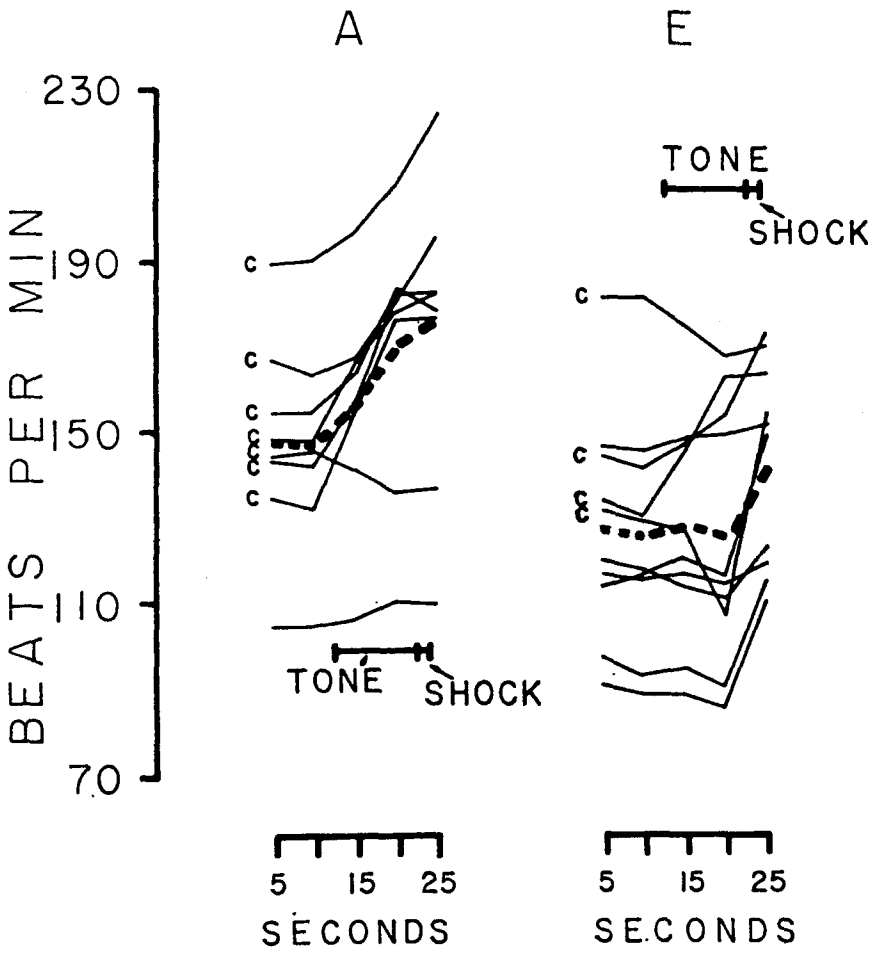

FIG. 5. Mean heart rate over 20 sessions for each A and E dog. "C" indicates statistically significant HR conditioning. Note that A dogs anticipate shock while many E dogs respond only at shock.

Electrocardiogram was recorded from each dog throughout the session. All 10 E dogs, but only 8 A dogs, were available for these sessions. Heart rate (HR) was obtained by counting the number of R-waves of the EKG before, during, and after the tones. Normally these were two 5-second counts just before the tone, two 5-second counts during tone and one 5-second count immediately following tone (Fig. 4). During the relatively few trials on which the dogs jumped, the jump occurred within 3–5 seconds after tone onset. In these cases HR was counted in 2.5-second periods: 2 before, 1 or 2 during tone, and 1 or 2 after tone, giving the usual 5 counts. All HR's were transformed to beats/min by multiplying by 12 for 5-second counts, or by 24 for 2.5-second counts.

Results. None of the 18 dogs jumped the bar on the first trial; therefore, all received shock on trial 1. Thus, the adaptive response

was not well retained after the 6–8 week rest. However, as Figure 4 shows, 7 of the 8 A dogs and 7 of the 9 E dogs (1 E dog's EKG was uncountable on trial 1) exhibited definite HR change during the first tone. Furthermore, 6 of the 7 A dogs showed HR increase, one showing HR decrease. On the other hand, of the 7 E dogs showing HR change, 6 showed decrease, while only 1 showed HR increase ($P < .05$).

We are showing the HR changes during the first tone which came *before* the first shock and therefore most likely represent retention of a cardiac conditional reflex. Mean HR's for 20 trials of each dog and group means for A dogs and E dogs are illustrated in Figure 5. As we have reported previously, E dogs tend to have lower heart rates than dogs of the normal A-line (Dykman, *et al.*, 1969; Newton, *et al.*, 1970). A more striking correlation is that between pre-tone HR level and the dogs' performances during the original bar-jumping sessions. High heart rate is an excellent reflection of the dogs having, during Experiment I, reached the criterion. Ten of the 11 dogs with HR's higher than 122 beats/min reached criterion, whereas 6 of 7 dogs with HR's lower than 122 failed ($\chi^2 = 7.6$, $P < .01$). Furthermore, all 12 dogs with HR's higher than 120 showed statistically significant *change* in HR (either HR increase or decrease) during the 20 tones presented in Experiment II, while none of the 6 dogs with HR's below 120 changed significantly.

Discussion

Some interesting features of this study are (1) the discontinuous, blocked or fragmented behavior characterized by the frozen or rigid postures of our nervous strain of dogs, and (2) the role of genetics both in the instrumental response acquisition and in the cardiovascular parameters. These latter are our only measured index of autonomic involvement, and it should be noted that many dogs were habitual, *i.e.*, conditioned "urinators" or "defecators" or barkers and howlers. We were accustomed to freezing and defecating of our nervous dogs with scarcity of howling, whereas our more normal line of dogs when aversely shocked were more apt to become hyperactive, often rolling over on their backs and howling. We can suggest very little to explain the striking correlation between the retained high heart rate and success at bar-jumping. Perhaps inordinate fright is responsible for both the disruption of learning and the slow HR's (probably a vagal effect).

Schizokinesis is, in our opinion, the best concept to account for the nervous system disharmony so frequently noted. It would seem

appropriate to apply it both to the fragmented overt behavior and to the discrepancy between expression of the motor bar-jumping and heart rate. As Gantt originally noted, the heart had remembered what the striate limbs had forgotten.

Maladaptation as Schizokinesis

It seems likely that the capacity for disorganized functioning is heritable in varying degrees and that this schizokinetic pathology, being a feature of the nervous system, could manifest itself in one or many organ systems. When comparing the normal acquisition of the bar-jumping response in healthy animals to the non-performance of the nervous animals, one is struck by the disharmony of function in the unsuccessful dog. His behavior is fragmented and non-integrated, often with widespread innervation of striate musculature. Pavlov (1928) and particularly Gantt (1944) have repeatedly expressed the conviction that the pathology in behavior is often to be found in the animal itself rather than in the animal's environment and experience. Gantt's conceptualizing (1953) of much of the pathologic process within the animal as schizokinesis, appears to be a more adequate analysis of this maladaptive type of behavior than currently proposed learning models. Mowrer's earlier two-factor views (1960), which he stated were really an outgrowth of Thorndike and Pavlov, clearly made use of "conditioned learning" and "solution learning." Thus the schism could sometimes lie squarely between the two factors in some of our dogs—those dogs which give evidence of autonomic conditioning but do not perform the instrumental act of jumping the bar. Other dogs, however, do not show evidence of any sort of conditioning. Their functioning is not linked to our stimuli though their eyes follow us with apparent hyper-vigilance. The schism here would therefore seem neurologically near the input. The fact that nearly appropriate behavior can be reinstated by manipulation, shoving, or sometimes the smallest of cues, implies a breach somewhere that is healed for a time. Maier (1949) found manual or forced guidance the best method for reinstating adaptive behavior in fixated rats. He further noted an important concreteness or stimulus-bound behavior in that animals fixated in jumping direction were not fixated when forced to walk the same routes. We too have noted a severe limitation in desensitizing the intense fear which our animals often display. A dog made friendly to a crouching man may be panic-stricken when the man simply stands up. The data at present suggest that our non-performing dogs have a rather widespread tendency to disorganization which is innate—a condition which concerned Gantt and Pavlov more than it did the learning theorists.

References

Breland, K., and Breland, M.: Animal Behavior, New York, Macmillan, 1966.

Dykman, R. A., Murphree, O. D., and Peters, J. E.: Like begets like: behavioral tests, classical autonomic and motor conditioning, and operant conditioning in two strains of pointer dogs. *Ann. N.Y. Acad. Sci.*, 159:976-1007, 1969.

Gantt, W. H.: Experimental Basis for Neurotic Behavior. New York, Paul B. Hoeber, 1944.

Gantt, W. H.: Principles of nervous breakdown—schizokinesis and autokinesis. *In* Comparative Conditioned Neuroses, *Ann. N.Y. Acad. Sci.*, 56:148-168, 1953.

Gantt, W. H., Newton, J. E. O., and Royer, F. L.: Development of the experimental neurosis: mechanism and factors. *Proc. 3rd World Congress of Psychiatry*, 2:991, 1969.

Garner, R.: Personal communication, 1969.

Maier, N. R. F.: Frustration: The Study of Behavior Without a Goal. New York, McGraw Hill, 1949.

Mowrer, O. H.: Learning Theory and Behavior. New York, Wiley and Sons, Inc., 1960.

Murphree, O. D., Dykman, R. A., and Peters, J. E.: Genetically-determined abnormal behavior in dogs: results of behavioral tests. *Cond. Reflex*, 2: 199-205, 1967.

Newton, J. E. O., and Gantt, W. H.: The history of a catatonic dog. *Cond. Reflex*, 3:45-61, 1968.

Newton, J. E. O., and Murphree, O. D.: Sporadic transient atrioventricular block and slow heart rate in nervous pointer dogs: a genetic study. *Cond. Reflex*, 5:75-89, 1970.

Pavlov, I. P.: Lectures on Conditioned Reflexes. Trans. and Ed., W. H. Gantt. New York, International Publishers, 358-369, 1928.